Electroformed Nickel Mirrors for NGST

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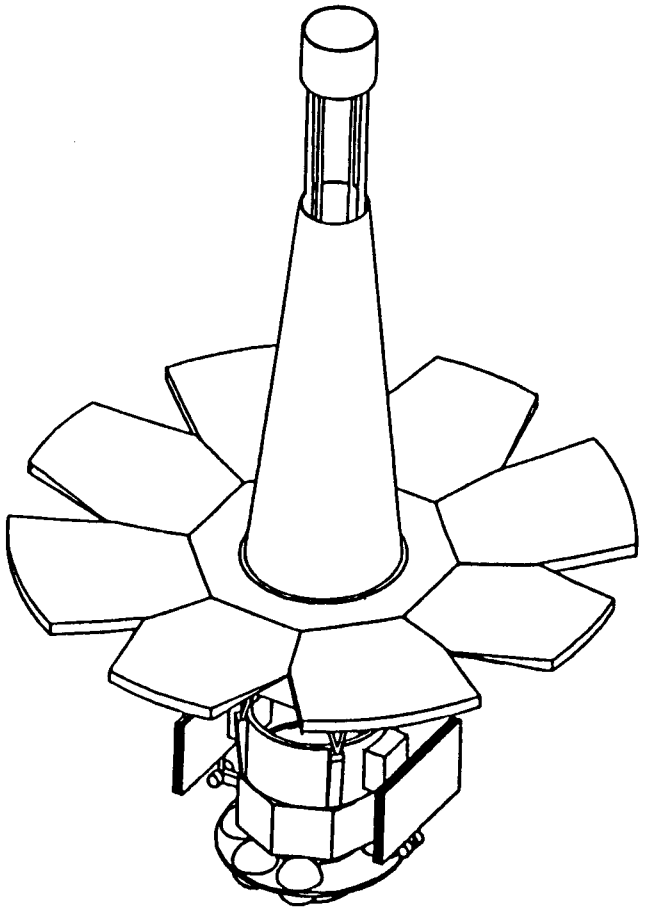
NASA/MSFC

NGST TECHNOLOGY CHALLENGE
GSFC July 7-10,1997

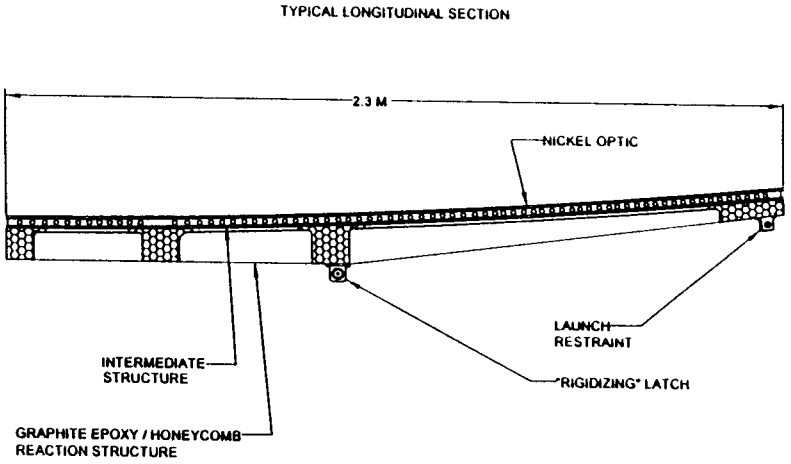
Contents:

- *NGST Primary Mirror Point Design*
- *Replication Process*
- *Prototype Mirrors*
- *Future Plans*

Optical Telescope Assembly



OTA



Sectional Views of Typical Petal

Mirror Requirements

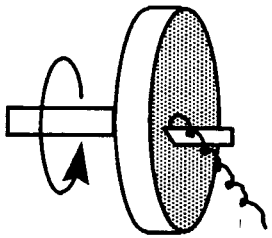
- *Deployed Primary Mirror*
- *Phase Adjustment on Primary Segments*
- *Lightweight Construction (15kg/m2)*
- *Deformable Quartenary*
- *60 Kelvin Operation*

Nickel Replication

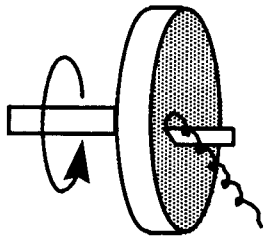
- *Nickel Electroforms can be fabricated in very low stress forms*
- *Complex Shapes (stiffeners, ribs, etc.)*
- *70ksi YS*
- *Wall thickness down to 0.5 mils*
- *Structures, Flexures, Mounting Provisions, etc., can be plated to the optic*
- *Excellent Surface Finish (< 10 Angstroms)*
- *Thickness variation less than 2%*
- *Untested Cryogenic Performance*

Replication Applied to Normal Incidence Optics

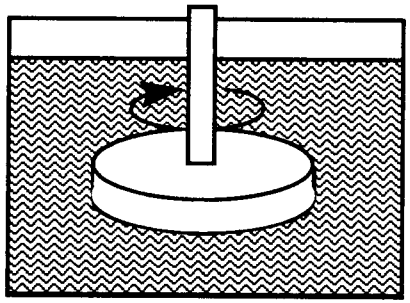
1. Machine



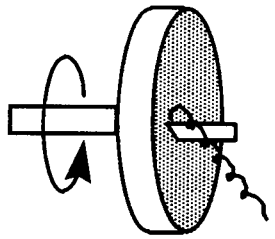
2. Single-Point Diamond Turn



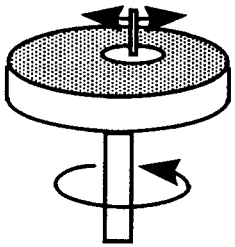
3. Electroless Nickel Plate



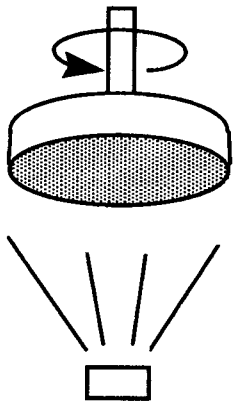
4. Single-Point Diamond Turn



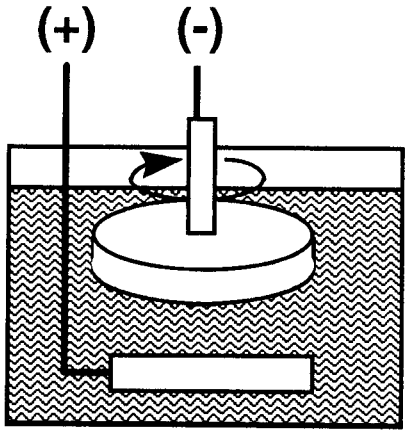
5. Polish



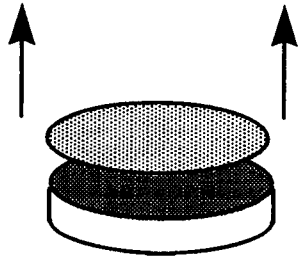
6. Apply reflective layer



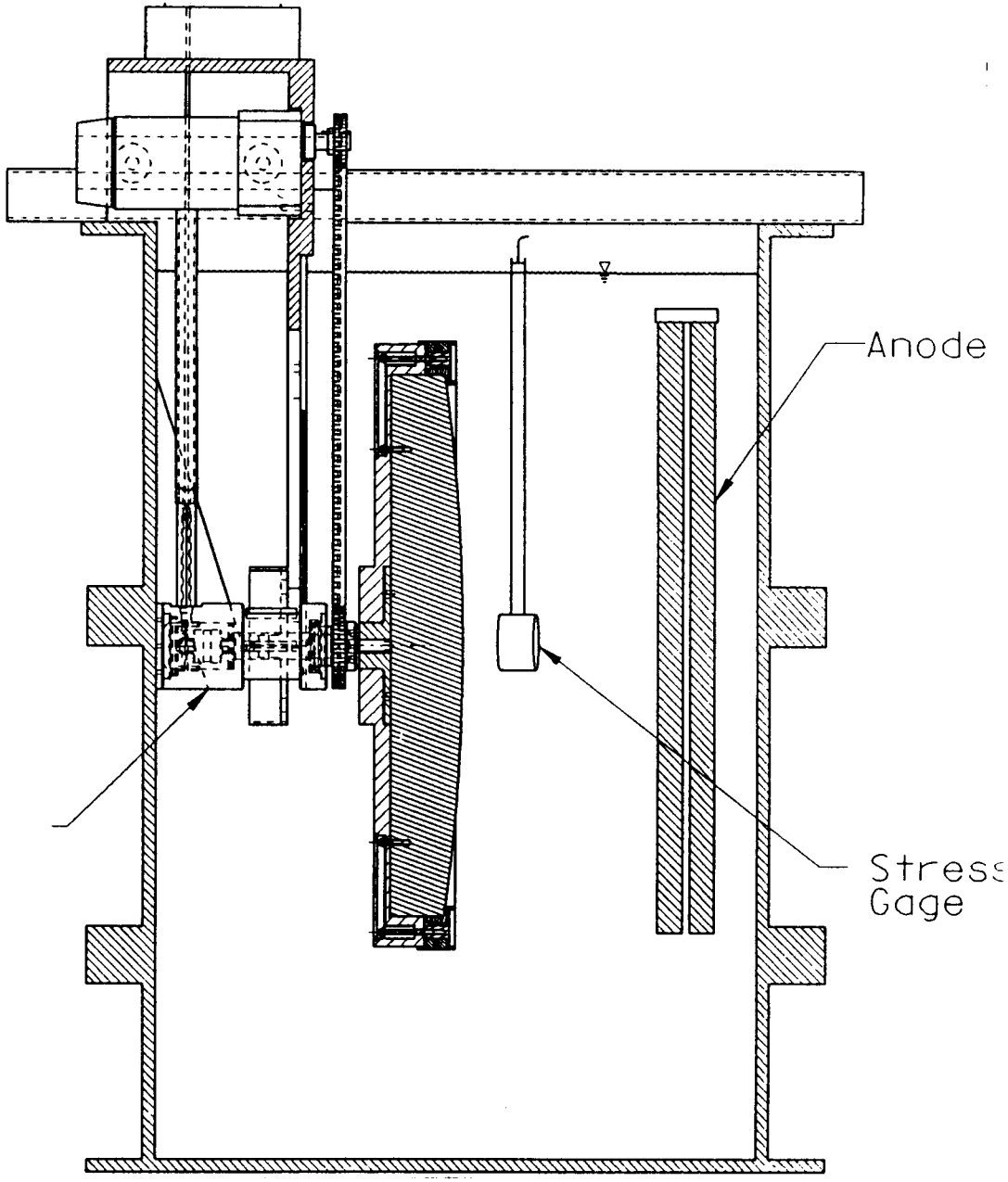
7. Electroform



8. Separate



NGST 4/16/96



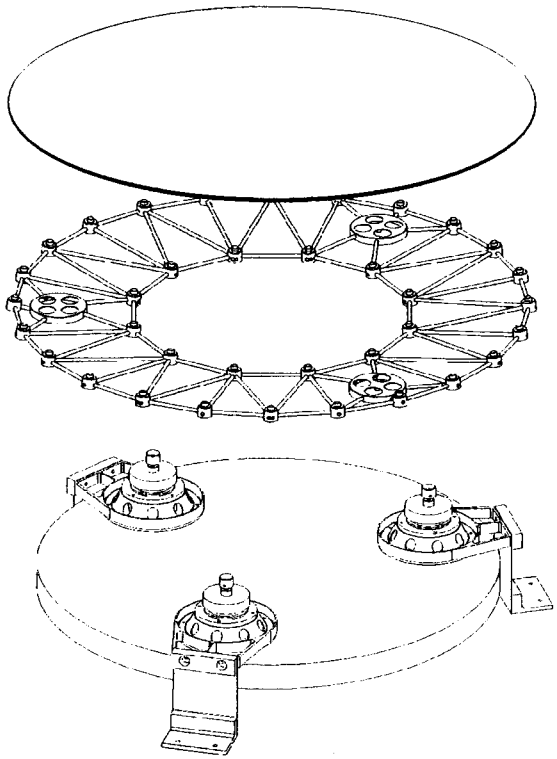
Electroforming Bath

PROPOSED

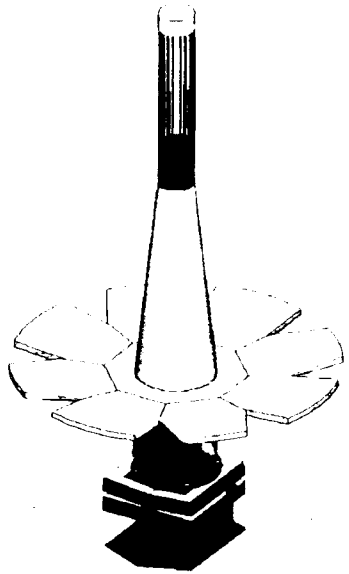
CENTER OF EXCELLENCE FOR SPACE OPTICS

George C. Marshall Space Flight Center

Replicated Optics



Half Meter NGST Prototype



NGST

REPLICATED OPTICS

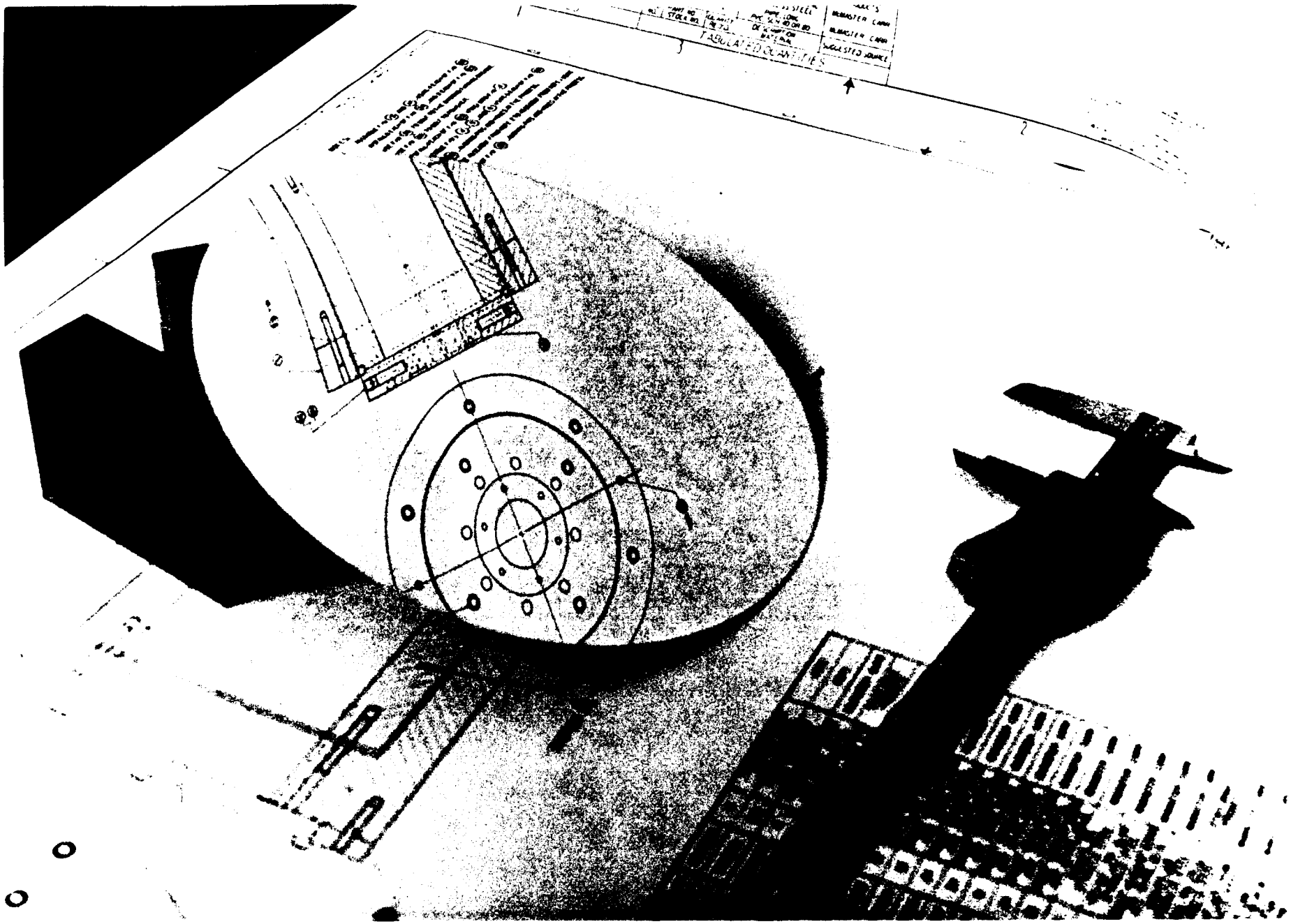
Nickel Replication

- Build subscale mirror configuratio
- Test

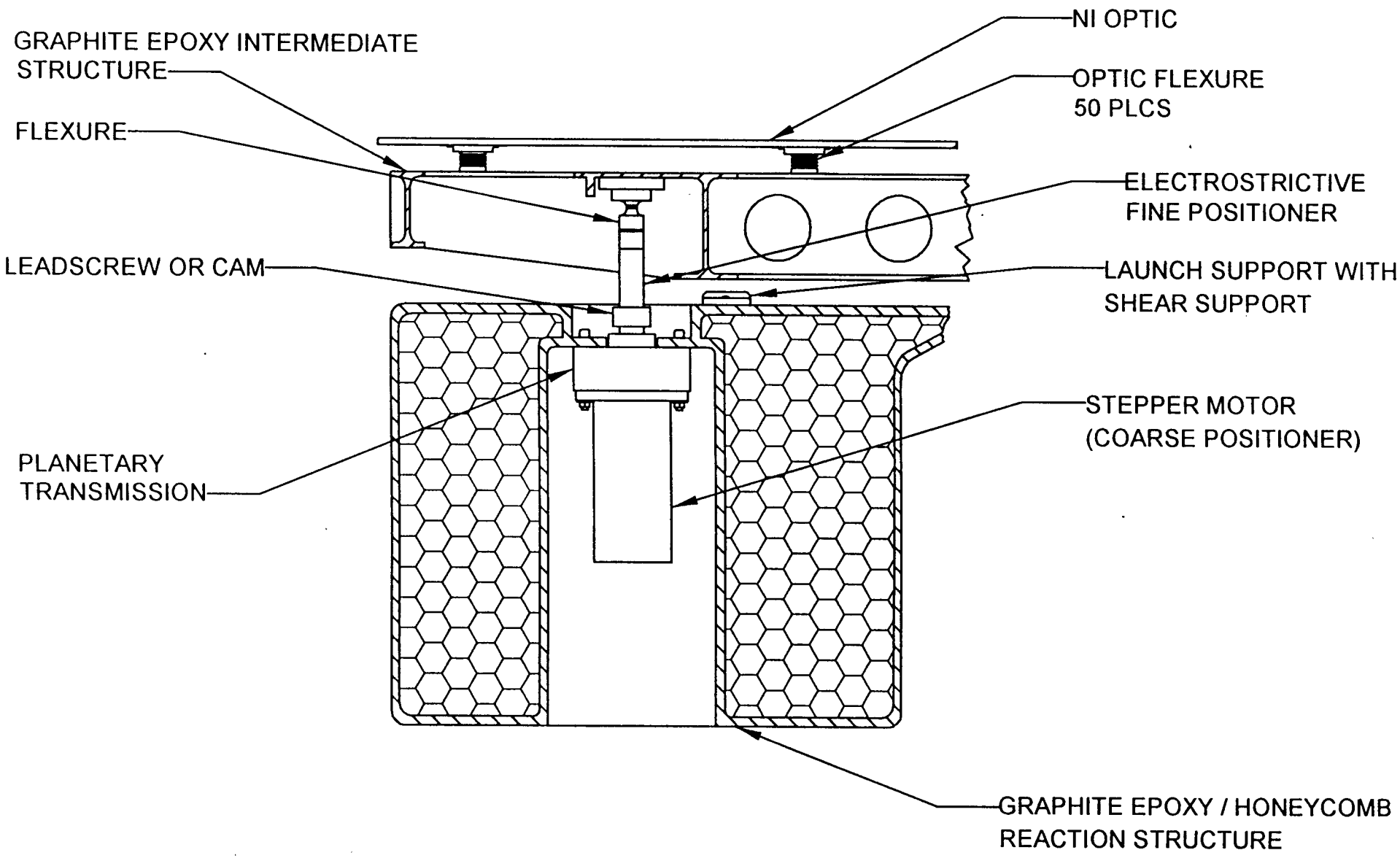
  Figure and Surface Quality — Plating Parameters

  Thermal Hysteresis — Vibro-acoustic

- 60 Kelvin Optical Test at JPL


TABULATED QUANTITIES

TYPICAL SECTION AT ACTUATOR



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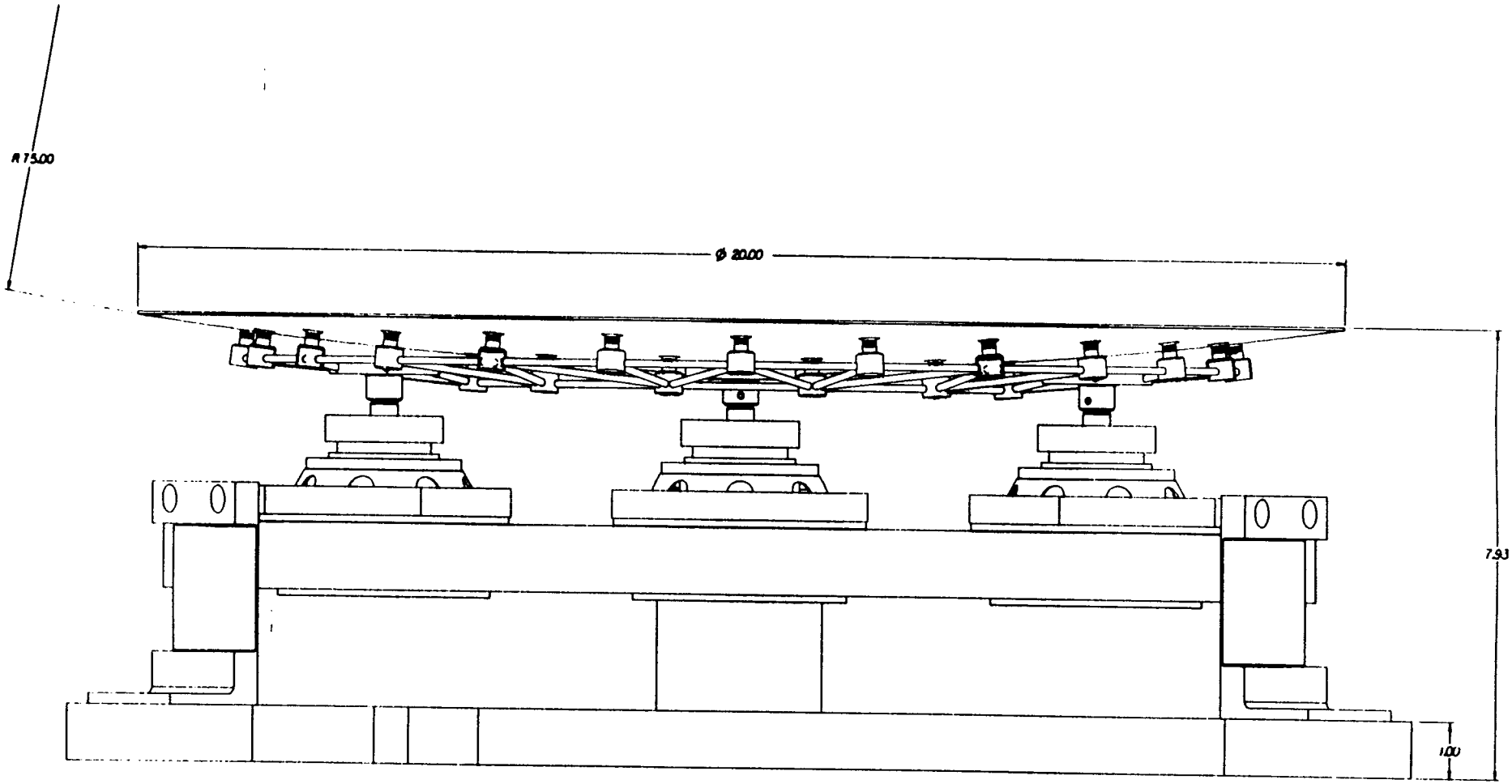
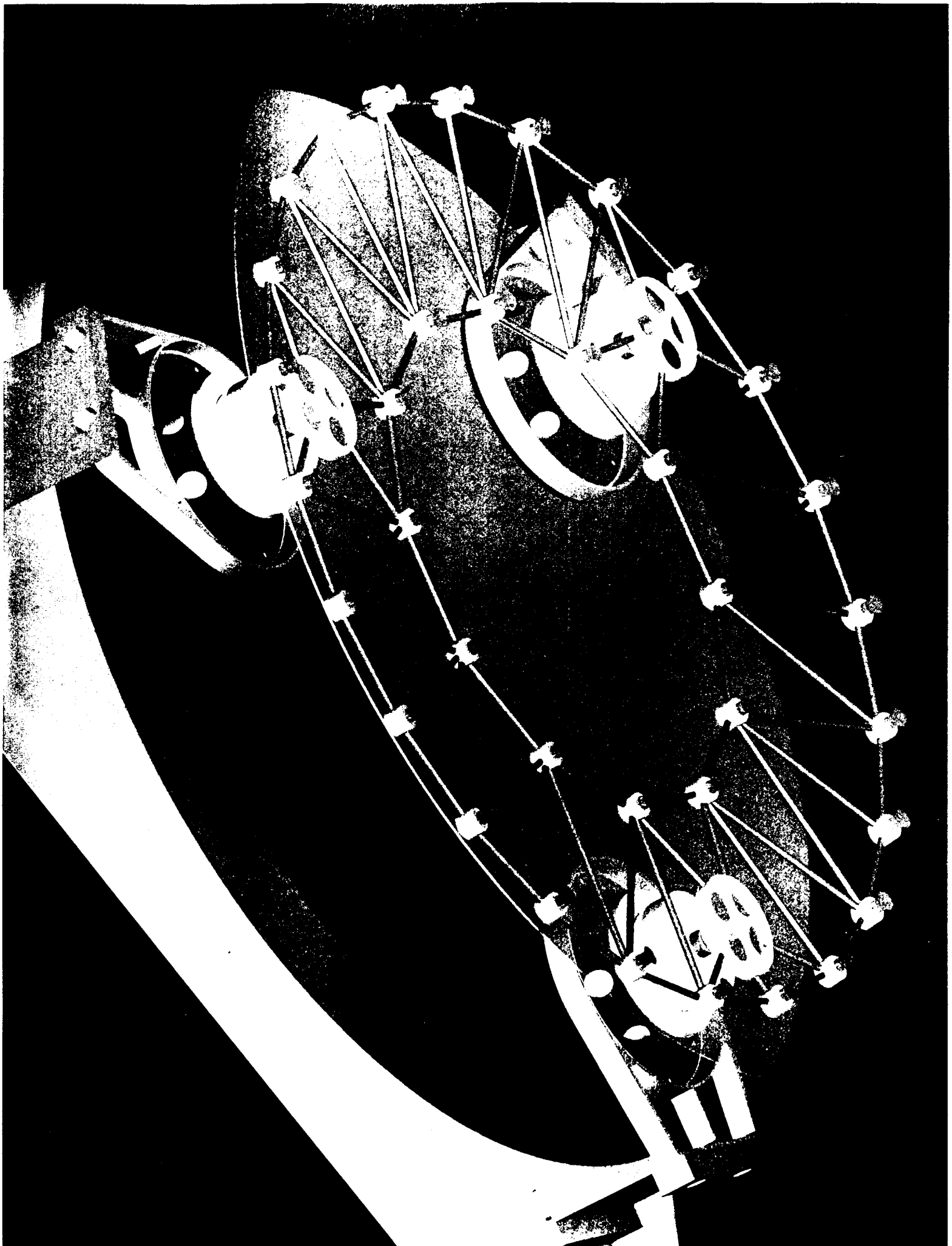
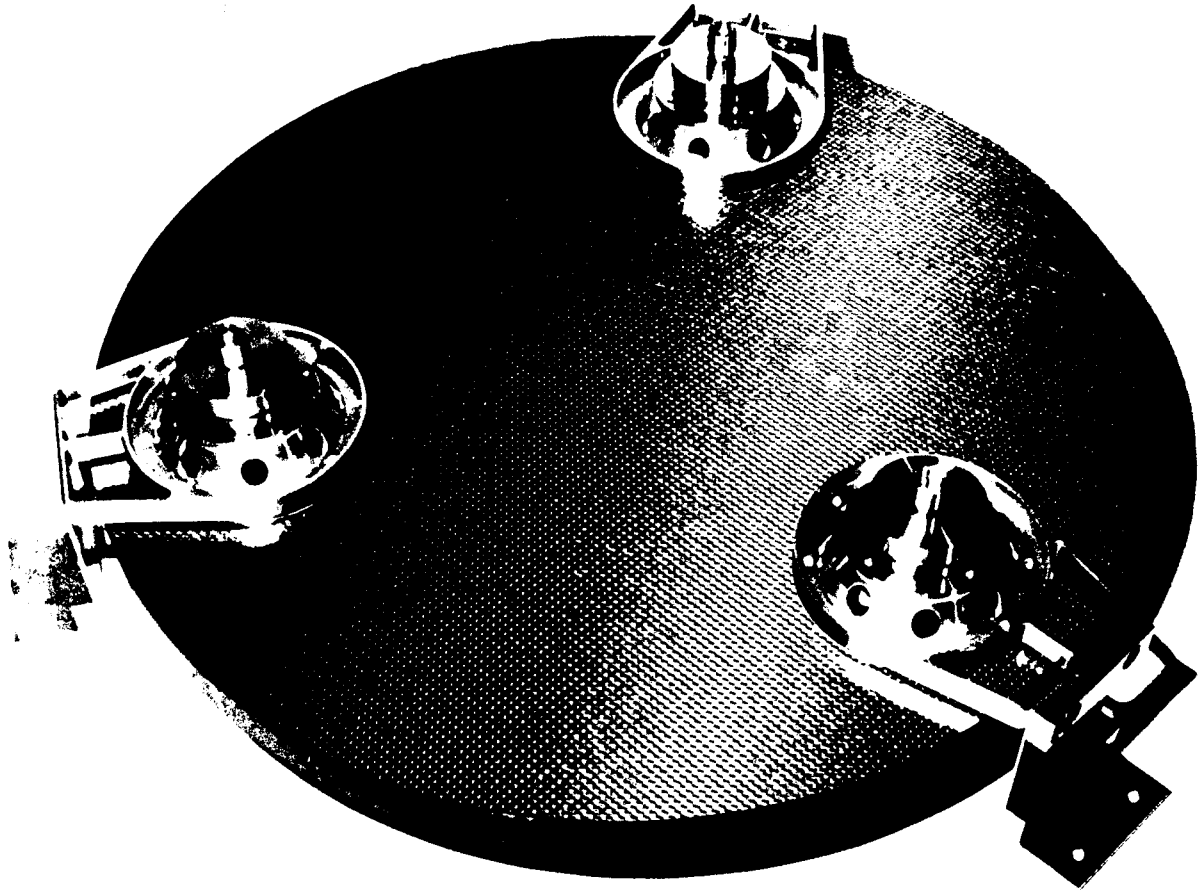




Prototype Status

- *First half-meter nickel mirror produced on 6/30/97*
- *Graphite Epoxy Structure Complete*
- *Flexure Plating trials underway*
- *Room temperature metrology and hysteresis testing underway*
- *60 K Optical Test*


LIBERTY



NASA

National Aeronautics and Space Administration

Future Plans

- *Larger Mirrors (1 meter plus)*
- *Design Options*
  - *Ribs, Flexures, etc.*
- *Tooling and Process*
  - *Enhanced Stress Gage*
  - *Mandrel "Cambering"*
- *Alloying*
  - *Additions of Cobalt and/or Iron*

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Acknowledgments:

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